Token-Based Platforms and Green Dilemma

Presenter: Bruce Si Yuan Jin

Joint work with Zitong Li, Allen H. Huang, Kar Yan Tam

December 17, 2023

Background

Figure: Centralized Data Platform

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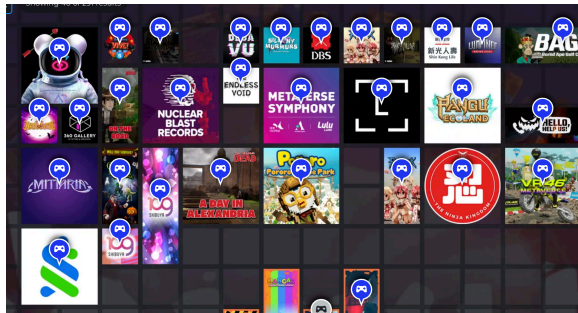
Figure: Centralized Data Platform

Figure: Decentralized Data Platform

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Decentralized database (securely and consistently records and verifies data across a decentralized network. (Hua et al., 2019; Sarker et al., 2021))

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- **3 trillion** $ token market size in 2021
  - Entrepreneurs
  - governmental entities[1]
  - venture capital

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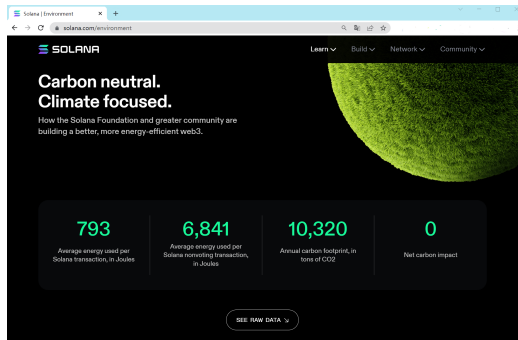
Foreground

Token-based Platform

Online platforms that leverage digital tokens as a means to secure asset ownership and facilitate their transactions (Belk et al., 2022; Cong and He, 2019).

- Example: Metaverse. Digital Assets Ownership (token).

What Happened?

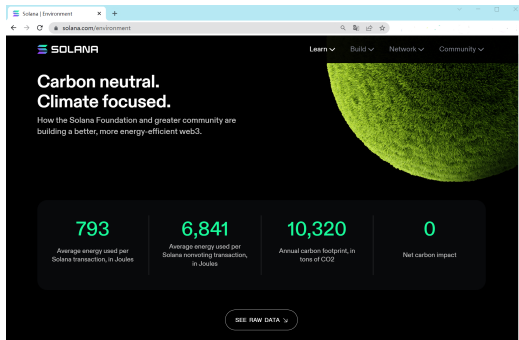- What: Environmental web pages (Since 2018).

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- Who: 40+ token-based platforms (> $300 million).
- **However!**
  - 7 in Jan 2018 – Mid 2021
  - 35 in Mid 2021 – Mar 2023

Practical Motivation

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  - **No additional actions**: (Ziolkowski et al., 2020)
    - Energy information = pre-determined consensus algorithms + the number of participating nodes

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- Disclosure has a low marginal cost.
  - **No additional actions**: (Ziolkowski et al., 2020)
    - Energy information = pre-determined consensus algorithms + the number of participating nodes
  - **No verification** (Christensen et al., 2021).

Puzzle 2

Why do they have time-dependent disclosure behavior?

Literature Motivation

Green Dilemma: Competing views of green effects on platforms' DSGRs.

Green-enhancing Effect

Platforms are incentivized to voluntarily disclose information to reduce information asymmetry (Howell et al., 2020) and improve reputations (Avramov et al., 2022).

Literature Motivation

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Green-costing Effect

- A waste of resources derived from agency problems between shareholders and managers (Krüger, 2015)
- Diverting attention away from a website's primary content, leading to information overload for token holders (Ghose et al., 2014; Hirshleifer and Teoh, 2003).

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- Serafeim (2021) suggest buyers in private markets do not care about firms' ESG performance as long as they maintain cash-generating capabilities.

Research Question

- **Question 1:** What drives token-based platforms to disclose environmental information?

Event Shock

- Elon Musk, on 12 May, 2021: Tesla suspended vehicle purchases using Bitcoin due to its environmental impact.

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- A change in community perceptions of mining's environmental impact (Cacioppo et al., 1986).
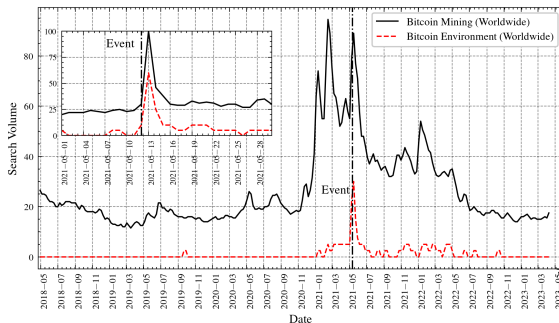
Elon Musk ✔
@elonmusk

Tesla & Bitcoin

Tesla has suspended vehicle purchases using Bitcoin. We are concerned about rapidly increasing use of fossil fuels for Bitcoin mining and transactions, especially coal, which has the worst emissions of any fuel.

Cryptocurrency is a good idea on many levels and we believe it has a promising future, but this cannot come at great cost to the environment.

Tesla will not be selling any Bitcoin and we intend to use it for transactions as soon as mining transitions to more sustainable energy. We are also looking at other cryptocurrencies that use <1% of Bitcoin's energy/transaction.

4:06 PM · 2021-05-12 · Twitter for iPhone

11.1K Retweets 7,747 Quote Tweets 56.7K Likes

Conceptual Layered Structure

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- **Infrastructure platforms (IPs)**: blockchain network, supporting data recording.
- **Application platforms (APs)**: operate tokens on multiple IPs without their own mining

Research Question

- What drives token-based platforms to disclose environmental information?
  - The event shock alters the community's perceptions that mining has severe environmental impacts, and actions are taken by IPs to respond to this change.

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- What drives token-based platforms to disclose environmental information?
  - The event shock alters the community's perceptions that mining has severe environmental impacts, and actions are taken by IPs to respond to this change.
  - **Model-free evidence**:
    - Google search index
    - All 40+ environmental pages were established by IPs.
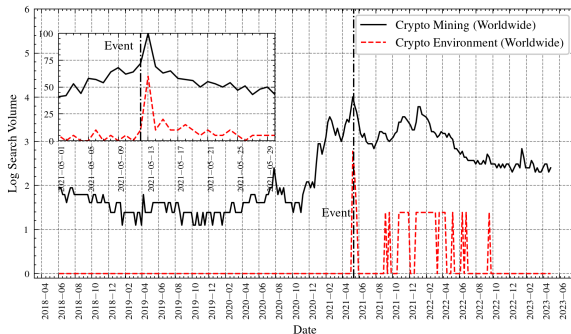
Research Question (Continued)

- How has the change in community perceptions influenced the environmental disclosure of token-based platforms?
- How has the change in community perceptions influenced their daily size growth rates (DSGRs)?
- How has the change in community perceptions influenced the relationship between environmental disclosure and the DSGRs of token-based platforms?

Empirical Setting
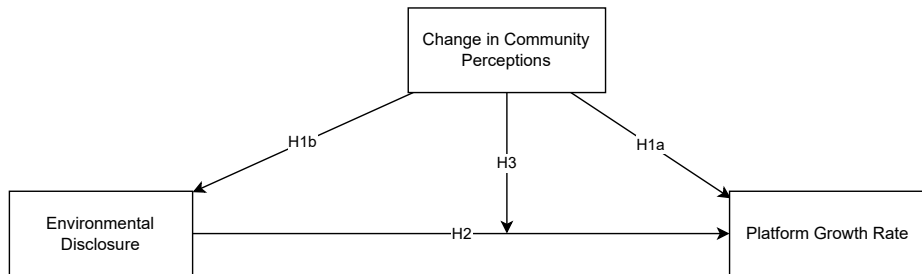
- May 12, 2021: Elon Musk's statement, discontinuing Tesla's acceptance of Bitcoin due to environmental concerns linked to Bitcoin mining.
- The shock is related to IPs rather than APs, as only IPs are directly related to mining.
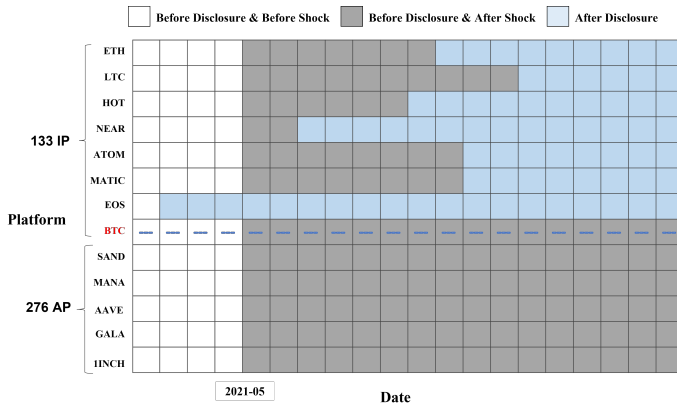
Hypothesis Development

- **Treatment group**: IPs
- **Control group**: APs
- **Measurement**: platform daily size growth rate (DSGR), an indicator of platform daily performance (Clementi and Hopenhayn, 2006; Evans, 1987).
- As the community's attitude has become that mining has negative environmental impacts:

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- **Measurement**: platform daily size growth rate (DSGR), an indicator of platform daily performance (Clementi and Hopenhayn, 2006; Evans, 1987).
- As the community's attitude has become that mining has negative environmental impacts:

Hypothesis

The change in community perceptions concerning mining's environmental impact led to the decreased DSGRs of IPs, but not APs.

Hypothesis Development

- To **alleviate concerns** about mining and meet the expectations of token holders (Cho and Patten, 2007), (Clementi and Hopenhayn, 2006; Evans, 1987), only IPs should disclose relevant information.

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Hypothesis

The change in community perceptions concerning mining's environmental impact led IPs, but not APs, to disclose environmental information via web pages.

Hypothesis Development

- **Green-enhancing effect after the change**: As suggested by Hypothesis 1, IPs underwent a decrease in DSGRs due to their environmental impacts.
- **Green-costing effect before the change**: environmental disclosure may have been viewed as unprofitable actions (Krüger, 2015), as
  - Only a few platforms disclosed environmental information

Hypothesis Development

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Hypothesis

The change in community perceptions moderates the association between IPs' environmental disclosures and their DSGRs such that the association is negative (positive) before (after) the change.

Event Data

- **Financial data**: Coinmarketcap.
- **Selection**: platforms with a market size of at least $100 million, starting from the first day a platform achieved this threshold and continuing until March 1, 2023.

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- **Selection**: platforms with a market size of at least $100 million, starting from the first day a platform achieved this threshold and continuing until March 1, 2023.
- **Baseline data**: 409 distinct platforms, totaling 23,570 platform-day observations. Timeframe: April 12, 2021, to June 12, 2021,

Data Exclusion

- **Bitcoin**: its direct association with Elon Musk's announcement
  - Bitcoin's decreased payment utility vs. its environmental implications

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- **Bitcoin**: its direct association with Elon Musk's announcement
  - Bitcoin's decreased payment utility vs. its environmental implications
- **Stablecoin**: part of APs, facilitate services based on IPs.
  - A bridge between fiat currencies and digital tokens, including IPs' tokens and APs' tokens.
  - Both IPs and APs' performance influence stablecoin platforms, leading to endogenous concerns.

Statistical Summary

Dependent variable: DSGR – the daily percentage change in platform size.

Baseline Sample	Count	Mean	Std	Min	Median	Max
Dependent Variable						
DSGR	23,570	–0.01	0.13	–3.38	–0.01	3.39
Explanatory Variables						
Post Shock	23,570	0.54	0.50	0.00	1.00	1.00
IP	23,570	0.33	0.47	0.00	0.00	1.00
Time Series Controls						
Prior Size (million)	23,570	2,372.21	17,668.40	0.96	207.43	482,881.90
Prior AllMktcap Change	23,570	–0.00	0.06	–0.26	–0.00	0.16
Prior Week Return	23,570	–0.06	0.26	–3.48	–0.05	3.43
Prior Month Return	23,570	–0.14	0.51	–4.18	–0.18	3.81
Prior 3-Month Return	23,570	0.69	0.96	–2.37	0.59	8.33
Supply (million)	23,570	6,913.43	42,605.23	0.0	246.12	766,307.71
Prior Close	23,570	812.14	6,048.65	0.00	1.00	82,745.19

Perception and DSGR

- **Method**: A DID approach with APs as the control group and IPs as the treatment group.

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- **Endogenous concern** from the layered structure
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- **Endogenous concern** from the layered structure
  - APs necessitate the payment of fees to function on the IPs
- To make them comparable, we incorporate the price and total supply amount of IPs' tokens as control variables because they are directly correlated with the operational costs of the APs:

$$Y_{it} = \alpha_i + \delta_t + \beta \times Post_t \times IP_i + Control_{i,t-1} + \epsilon_{i,t} \tag{1}$$

Perception and DSGR Results

DV: DSGR	(1)	(2)	(3)	(4)	(5)	(6)
Post Shock:IP	−0.0053**	−0.0147***	−0.0144***	−0.0053**	−0.0147***	−0.0144***
	(0.0026)	(0.0029)	(0.0029)	(0.0022)	(0.0031)	(0.0049)
Fee Control	No	Yes	Yes	No	Yes	Yes
Size Control	No	No	Yes	No	No	Yes
Effects	Entity Time	Entity Time	Entity Time	Entity Time	Entity Time	Entity Time
No. Observations	23,570	23,570	23,570	23,570	23,570	23,570
Cov. Est.	Robust	Robust	Robust	Clustered	Clustered	Clustered
R-squared	0.0002	0.0052	0.0348	0.0002	0.0052	0.0348

Result 1

After the shock, IPs' DSGRs decrease more than that of APs'.

Event Study

- **Concern**: The APs and IPs may not be comparable entities.
- **Method**: Parallel trend assumption checking with the event study:

$$Y_{it} = \alpha_i + \delta_t + \sum_{k=-5, k\neq-1}^{5} \beta_{k(t)} \times IP_i + Control_{i,t-1} + \epsilon_{i,t} \tag{2}$$
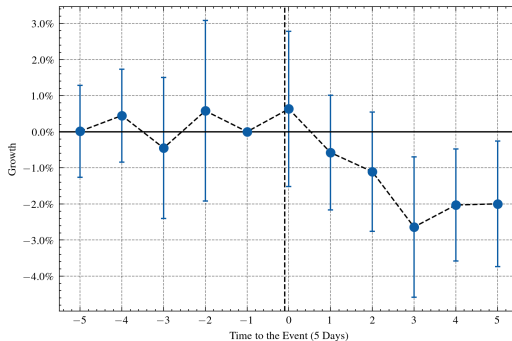
After-Event Environmental Disclosure Data

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- **Final Panel data**: 85 IPs, of which 41 had published an environmental web page. Final panel data: 40,768 observations from May 12, 2021, to March 1, 2023.

Symbol	Web Page	Launch Date
EOS	https://eosauthority.com/green/	2018-11-25
XRP	https://xrpl.org/carbon-calculator.html	2020-10-21
NEAR	https://near.org/blog/near-climate-neutral-product/	2021-04-15
ALGO	https://algorand.com/about/sustainability	2021-04-22
CSPR	https://blog.casperlabs.io/new-power-usage-report-shows-the-casper-networks-impressive-energy-efficiency-relative-to-other-blockchain-protocols/	2021-05-04
HOT	https://www.holochain.org/projects/#energy_project	2021-05-05
MOB	https://mobilecoin.com/blog/mobilecoin-saves-on-environmental-footprint	2021-05-11
CRO	https://crypto.com/company-news/crypto-coms-climate-commitment-2	2021-05-27
...	...	...

Perception and Env Disclosure

To examine the impact of the change in community perceptions on the adoption of web page environmental disclosures:

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- **Method**: Chi-square test to assess the statistical significance of the change in the number of such disclosures during the pre and after-shock periods.

IP	Published	Not Published	Total	AP	Published	Not Published	Total
Before Change	7	78	85	Before Change	0	105	105
After Change	34	51	85	After Change	0	105	105
Total	41	130	170	Total	0	210	210

$$\chi^2 = \frac{(7 - 16.65)^2}{16.65} + \frac{(78 - 68.35)^2}{68.35} + \frac{(34 - 24.35)^2}{24.35} + \frac{(51 - 60.65)^2}{60.65} = 8.36.$$

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Result 2

A significant increase in the number of IPs, not APs, that published environmental pages.

Statistical Summary

IP Panel Data	Count	Mean	Std	Min	Median	Max
Dependent Variable						
DSGR	40,768	–0.00	0.07	–1.44	0.00	1.50
Explanatory Variables						
Post	40,768	0.06	0.24	0.00	0.00	1.00
E	40,768	0.33	0.47	0.00	0.00	1.00
Time Series Controls						
Prior Size (million)	40,768	7,486.35	35,054.28	14.73	1,073.44	569,094.33
Prior AllMktcap Change	40,768	–0.00	0.04	–0.26	0.00	0.16
Prior Week Return	40,768	–0.02	0.24	–13.54	–0.01	2.30
Prior Month Return	40,768	–0.08	0.53	–13.70	–0.07	2.46
Prior 3-Month Return	40,768	–0.22	0.92	–14.42	–0.20	3.83
Prior Close	40,768	57.88	314.22	0.00	1.04	23,147.35
Supply	40,768	280,233.23	2,126,310.56	2.42	875.25	19,320,892.17
Heterogeneous Effects						
Address	40,768	0.41	0.49	0.00	0.00	1.00
Registration	40,768	0.44	0.50	0.00	0.00	1.00

Environmental Disclosure and IPs' DSGRs

- Staggered adoption of environmental web pages
- **Method**: a staggered adoption DID method to test the effects of web page environmental disclosure. Our model is as follows:

$$Y_{it} = \alpha_i + \delta_t + \beta \times Post_{it} + Control_{i,t-1} + \epsilon_{i,t} \tag{3}$$

where Y_{it} represents DSGRs of platform i in day t. $Post_{it}$ represents the web page launch dummy variable for platform i on day t. We incorporate both platform-level fixed effects α_i and year-by-month-by-day fixed effects δ_t.

Environmental Disclosure and IPs' DSGRs

DV: DSGR	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.0029**	0.0029**	0.0029**	0.0029**	0.0029**	0.0029**
	(0.0012)	(0.0012)	(0.0012)	(0.0014)	(0.0014)	(0.0014)
Size Control	Yes	Yes	-0.0084***	Yes	Yes	Yes
Effects	Entity	Entity	Entity	Entity	Entity	Entity
	Time	Time	Time	Time	Time	Time
No. Observations	40,768	40,768	40,768	40,768	40,768	40,768
Cov. Est.	Robust	Robust	Robust	Clustered	Clustered	Clustered
R-squared	0.0045	0.0045	0.0050	0.0050	0.0077	0.0077

Result 3

IPs' DSGRs increase after the environmental disclosure.

Environmental Disclosure and IPs' DSGRs

DV: DSGR	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.0029**	0.0029**	0.0029**	0.0029**	0.0029**	0.0029**
	(0.0012)	(0.0012)	(0.0012)	(0.0014)	(0.0014)	(0.0014)
Size Control	Yes	Yes	-0.0084***	Yes	Yes	Yes
Effects	Entity	Entity	Entity	Entity	Entity	Entity
	Time	Time	Time	Time	Time	Time
No. Observations	40,768	40,768	40,768	40,768	40,768	40,768
Cov. Est.	Robust	Robust	Robust	Clustered	Clustered	Clustered
R-squared	0.0045	0.0045	0.0050	0.0050	0.0077	0.0077

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IPs' DSGRs increase after the environmental disclosure.

- **Falsification Test (Pass):**
  - **Concern**: Any web page may lead to an increased DSGR anyway.

Environmental Disclosure and IPs' DSGRs

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Post	0.0029**	0.0029**	0.0029**	0.0029**	0.0029**	0.0029**
	(0.0012)	(0.0012)	(0.0012)	(0.0014)	(0.0014)	(0.0014)
Size Control	Yes	Yes	−0.0084***	Yes	Yes	Yes
Effects	Entity	Entity	Entity	Entity	Entity	Entity
	Time	Time	Time	Time	Time	Time
No. Observations	40,768	40,768	40,768	40,768	40,768	40,768
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  - **Concern**: Any web page may lead to an increased DSGR anyway.
  - **Method**: Social pages as a comparison.

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- Staggered adoption DID regression model with a heterogeneous time variable $Before_t$:

$$Y_{it} = \alpha_i + \delta_t + \beta \times Before_t \times Post_{it} + \gamma_1 \times Post_{it} + Control_{i,t-1} + \epsilon_{i,t} \qquad (4)$$

where Y_{it} is the DSGR for platform i on day t. $Before_t$ is a dummy indicator showing whether the time is before the shock. $Post_{it}$ is a dummy variable indicating whether platform i has launched its web page by day t. we incorporate both platform-level fixed effects α_i and year-by-month-by-day fixed effects δ_t. $Before_t$ is absorbed by the fixed effects as it is unit-invariant.

Effects with Different Community Perception

DV: DSGR	(1)	(2)	(3)	(4)	(5)	(6)
Post:Before	−0.0102**	−0.0102***	−0.0098**	−0.0098***	−0.0097**	−0.0097***
	(0.0044)	(0.0023)	(0.0044)	(0.0021)	(0.0044)	(0.0021)
Post	0.0030***	0.0030***	0.0029***	0.0029***	0.0029***	0.0029***
	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)
Effects	Entity Time	Entity Time	Entity Time	Entity Time	Entity Time	Entity Time
No. Observations	67,330	67,330	67,330	67,330	67,330	67,330
Cov. Est.	Robust	Clustered	Robust	Clustered	Robust	Clustered
R-squared	0.0025	0.0025	0.0028	0.0028	0.0031	0.0031

Result 3

The change in community perceptions **increases the effect of web page environmental disclosures** as IPs' DSGRs decrease more during the before-shock period than the after-shock period.

Regulatory Risk

- The token market is **not regulated** in terms of environmental disclosure.
  - In loosely regulated markets, investors tend to **disregard regulatory risks** (Ilhan et al., 2021; Avramov et al., 2022).
  - Otherwise, platforms subject to stricter regulation would benefit more from such disclosures because of their **increased regulatory risks** (Avramov et al., 2022).
- **Regulatory Indicator**:
  - *Registration*: whether a platform is officially recognized as a legal entity in a particular country
  - *Address* - whether a platform is officially registered with a full address for its organization.
- A staggered adoption DID with different levels of regulation degree:

$$Y_{it} = \alpha_i + \delta_t + \beta \times Registration_i \times Post_{it} + \gamma_1 \times Post_{it} + Control_{i,t-1} + \epsilon_{i,t} \qquad (5)$$

Heterogeneous Regulation

DV: DSGR	(1)	(2)	(3)	(4)
Post:Registration	-2.259e-05	-2.259e-05		
	(0.0024)	(0.0027)		
Post:Address			0.0016	0.0016
			(0.0024)	(0.0025)
Post	0.0029*	0.0029*	0.0022	0.0022
	(0.0016)	(0.0017)	(0.0017)	(0.0014)
Effects	Entity	Entity	Entity	Entity
	Time	Time	Time	Time
No. Observations	40,768	40,768	40,768	40,768
Cov. Est.	Robust	Clustered	Robust	Clustered
R-squared	0.0077	0.0077	0.0077	0.0077

Regulation Concern

Different levels of regulation degree **do not lead to a significant difference** in the effect of environmental disclosures on IPs' DSGRs.

Conclusion

Three hypothesises are valid:

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Results: After the perception change

- IPs' DSGRs decrease more than that of APs'.
- A significant increase in the number of IPs, not APs, that published environmental pages.
- **The effect of web page environmental disclosures increases**.

Contribution

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- **CSR Literature**: social pressure itself can influence environmental disclosure decisions even in the absence of potential regulatory requirements.

Implications

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- Token holders: aware of the community's perceptions and integrate them into their investment strategies.

The End

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